US007389821B2

(12) United States Patent
Xu

(10) Patent No.: US 7,389,821 B2
(45) Date of Patent: Jun. 24, 2008

(54) DOWNHOLE TRIGGER DEVICE HAVING EXTRUDABLE TIME DELAY MATERIAL

(75) Inventor: **Yang Xu**, Houston, TX (US)

(73) Assignee: **Baker Hughes Incorporated**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 65 days.

(21) Appl. No.: **11/598,966**

(22) Filed: **Nov. 14, 2006**

(65) **Prior Publication Data**

US 2008/0110615 A1 May 15, 2008

(51) **Int. Cl.**
E21B 23/08 (2006.01)

(52) **U.S. Cl.** **166/381**; 166/319; 166/383

(58) **Field of Classification Search** 166/381, 166/383, 120, 319

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

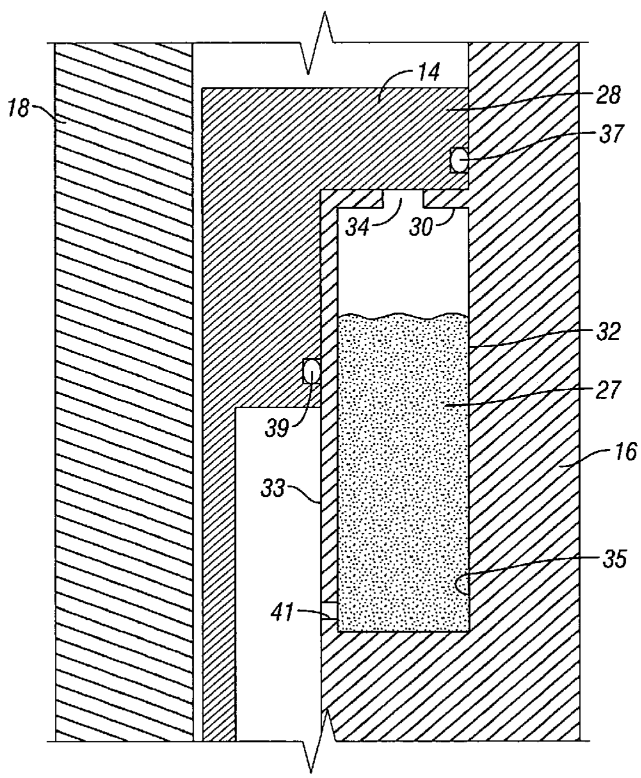
4,178,992 A 12/1979 Regan et al.
4,379,722 A 4/1983 Scott
4,621,987 A 11/1986 Spingath, Jr.
4,705,118 A 11/1987 Ennis
4,771,831 A 9/1988 Pringle et al.
5,046,557 A 9/1991 Manderscheid
5,398,998 A 3/1995 Evans
5,441,111 A 8/1995 Whiteford
5,752,814 A 5/1998 Starks et al.
6,142,227 A 11/2000 Hiorth et al.
6,923,263 B2 8/2005 Eden et al.
2002/0088616 A1 7/2002 Swor er al.
2004/0040710 A1 3/2004 Eden et al.
2005/0241855 A1 11/2005 Wylie et al.
2006/0005968 A1 1/2006 Vinegar et al.

Primary Examiner—David J. Bagnell
Assistant Examiner—Brad Harcourt
(74) *Attorney, Agent, or Firm*—Greenberg Traurig LLP; Anthony F. Matheny

(57) **ABSTRACT**

A trigger device for setting a downhole tool includes a retaining member that restricts the downhole tool from setting until it is properly positioned within the well and a force acts upon an actuating member. The retaining member includes an extrudable material that extrudes through an orifice when the force acts upon the actuating member. The extrudable material is preferably one that moves at a known rate so that the amount of time necessary for the downhole tool to set is pre-determined.

20 Claims, 2 Drawing Sheets



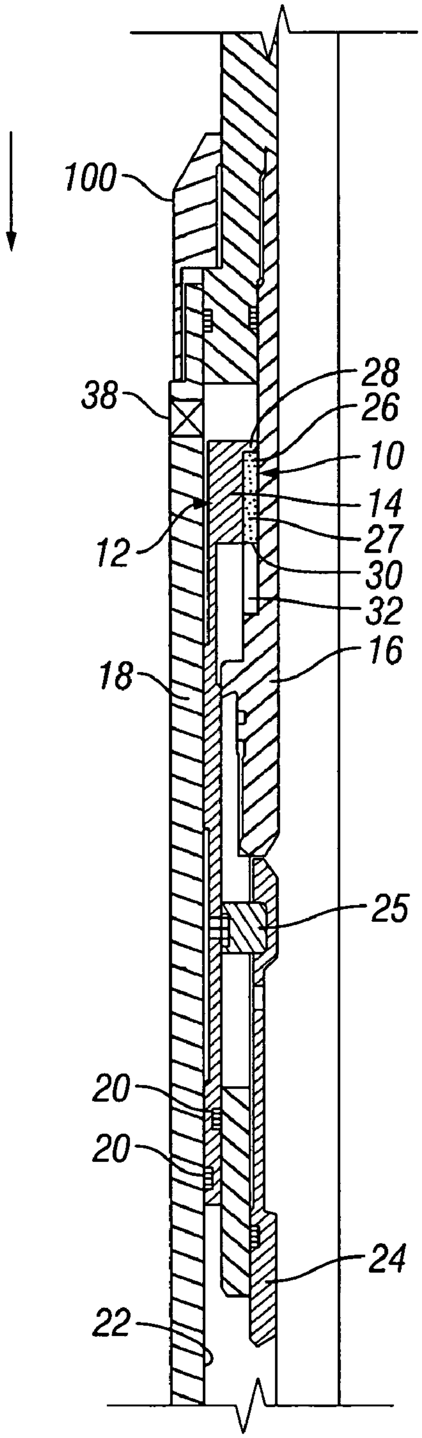

100
38
28
26
10
14
12
27
30
32
16
18
25
20
20
24
22

FIG. 1

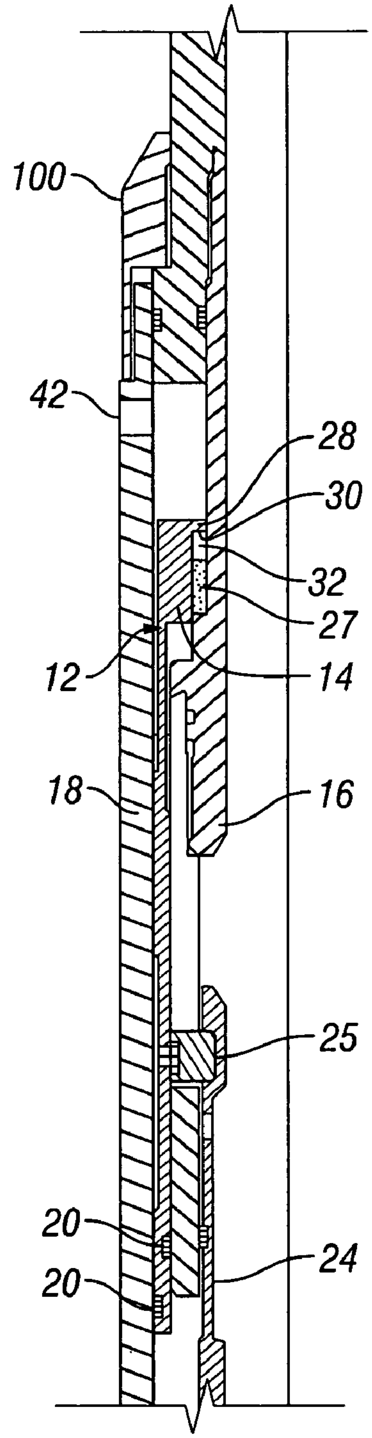

100
42
28
30
32
27
12
14
18
16
25
20
20
24

FIG. 2

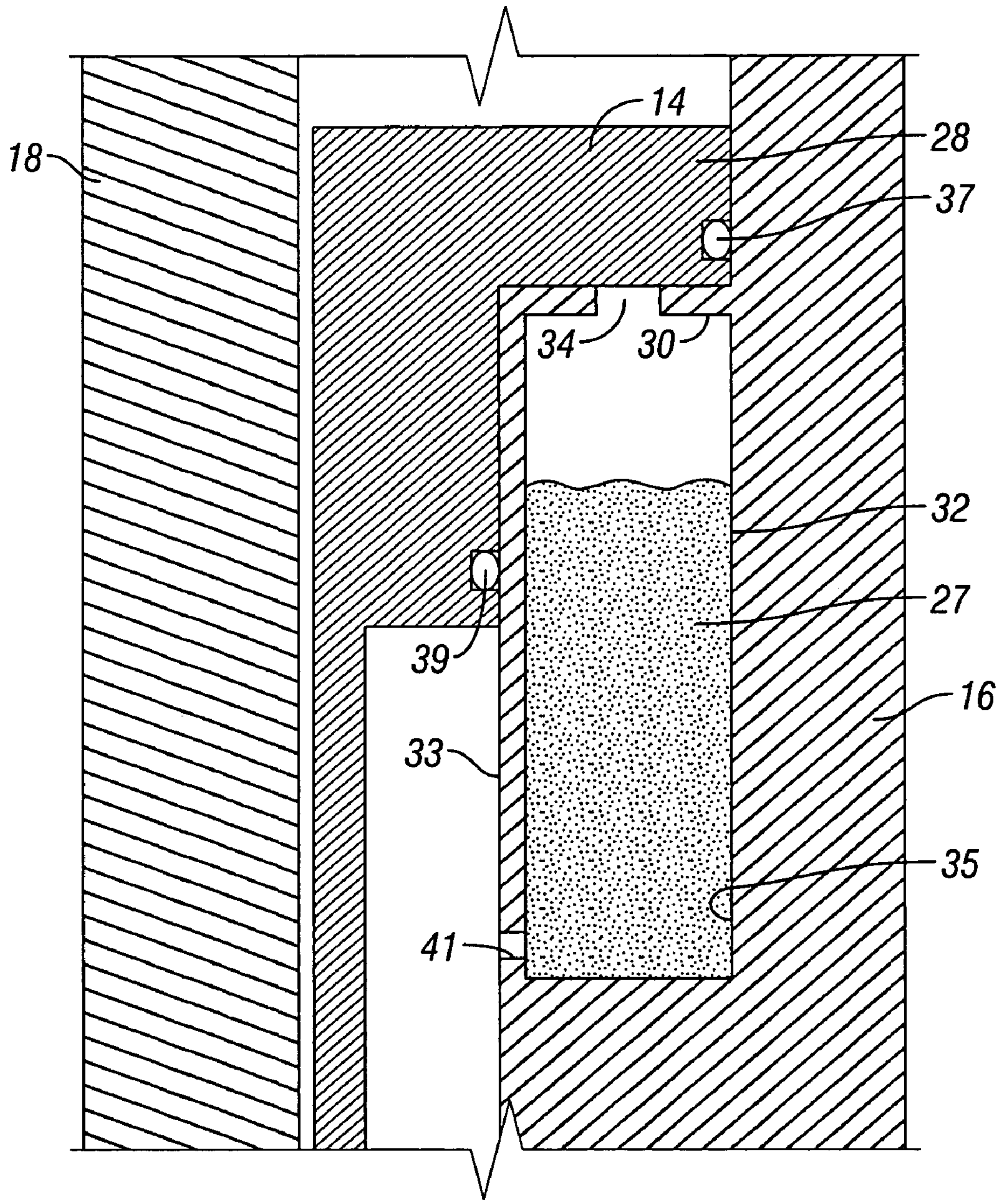


FIG. 3

DOWNHOLE TRIGGER DEVICE HAVING EXTRUDABLE TIME DELAY MATERIAL

BACKGROUND

1. Field of Invention

The present invention is directed to trigger devices for actuating downhole tools and, in particular, trigger devices having an extrudable material such that when the extrudable material is moved, e.g., compressed or extruded, by an actuating member in the trigger device so that the actuating member moves at a steady, known rate to actuate the downhole tool.

2. Description of Art

Some downhole tools need to be retained in an unset position until properly placed in the well. It is only when they are properly located within the well that the downhole tool is set. Such downhole tools in the past have had trigger mechanisms that are retained in an immovable position while the downhole tool is being "run" into the well and properly placed within the well. One prior technique for holding the trigger mechanism immobile until the downhole tool is properly placed in the well involves disabling the trigger with a mechanical device that is held against movement by a Kevlar® high strength fiber and an associated electrically powered heat source generally powered by stored batteries in the downhole tool. The generation of sufficient heat burns the fibers and releases the trigger so that the tool can set. Such a system is described in U.S. Pat. No. 5,558,153. One problem with this trigger mechanism is that it is extremely difficult to generate sufficient heat downhole to burn the fibers without damaging adjacent components. This is because the physical size of the battery pack must be large enough to provide sufficient energy to generate the necessary temperature, for the necessary duration, to break the fibers. Another issue is the very high temperatures needed to break the fibers and the effect on the overall design of the downhole tool from having to keep heat sensitive components away from the heated area.

Another prior trigger mechanism includes a battery operated heater coil in a downhole tool to release the trigger by applying heat and melting a plug to start the setting sequence. This design is reflected in U.S. Pat. No. 6,382,234. As with the other prior attempt, the size of the battery to provide the required electrical capacity to create enough heat to melt the plug presents a space concern in a downhole tool where space for a large power supply is at a premium. Further, the heat sensitive components must be shielded from the heater coil. The cost and the reliability of a large battery pack is also can be a problem. Additionally, safety is another issue because some batteries need special shipping and handling requirements.

Still other alternatives involve the large battery pack to accomplish a release of the trigger. For example, U.S. Pat. No. 5,558,153 also suggests using solder wire that melts at relatively low temperatures to be the trigger material or using the stored power in the battery to advance a knife to physically cut the fiber as opposed to breaking it with a battery operated heat source.

Accordingly, prior to the present inventions trigger devices and methods for actuating downhole tools have been desired in the art which: permit customization of the trigger device such that the amount of time for the trigger device to be activated is predetermined; permit steady movement of the actuating device at a known rate; and permit setting of downhole tools without the need for heat from an external heating source other than wellbore temperature.

SUMMARY OF INVENTION

Broadly, the trigger devices for downhole tools have a housing or body, an actuating member, and a retaining member. The retaining member includes an extrudable material. The retaining member prevents movement of the actuating member until the extrudable material of the retaining member is moved, e.g, extruded or forced out of the path of movement of the actuating member. As the extrudable material is moved the actuating member moves and, thus, sets the downhole tool. In certain specific embodiments, the movement of the extrudable material sets the downhole tool by one or more of freeing a piston to move or by any other mechanism known to persons skilled in the art.

The extrudable material may be any material known to persons of ordinary skill in the art. Preferably, the extrudable material operates as a time delay device that can be calibrated with the passage of time. Thus, the extrudable material permits movement of the actuating member within a known period of time such that the downhole tool, regardless of type of downhole tool, can be placed in a desired location in the wellbore and the downhole tool actuated within a known period of time. Accordingly, the extrudable material has a known rate of movement such that an operator of the downhole tool is able to predetermine the amount of time for the extrudable material to sufficiently move so that the actuating member can move and, thus, set the downhole tool.

Further, because the extrudable materials can be easily calibrated, they can be customized for various depth wells, and various wellbore temperatures. The extrudable materials can also be customized to sufficiently move and allow setting of various downhole tools.

Additionally, the inclusion of the extrudable material to assist maintenance of the downhole tool in its "unset" or "run-in" position permits the easy formation of various sized trigger devices depending on the size of the housing or chamber of the downhole tool in which the trigger device is placed. As necessary, additional or less extrudable material may be used to form the retaining member to properly fit within the housing of the downhole tool.

Further, movement of the extrudable material does not require generation of heat from a heat source other than the wellbore temperature. As a result, no heating element or batteries are required. Therefore, a simpler, more efficiently sized, and less expensive designed downhole tool is achieved.

In one aspect, one or more of the foregoing advantages have been achieved through a trigger device for a downhole well tool, the trigger device capable of selectively actuating the downhole tool. The trigger device comprises a housing; an actuating member operatively carried by the housing, wherein the movement of the actuating member from a first position to a second position causes a downhole tool to perform a specified function; and a restraining member operatively associated with the actuating member to initially prevent movement of the actuating member from the first position to the second position, the restraining member comprising a solid extrudable material adjacent an opening, wherein a selected force acting on the actuating member causes the actuating member to push at least a portion of the extrudable material through the opening, allowing the actuating member to move from the first position to the second position.

A further feature of the trigger device is that the actuating member may comprise a piston. Another feature of the trigger device is that the extrudable material may be mounted in contact with the piston. An additional feature of the trigger device is that the opening may be located in a shoulder in the housing and the extrudable material is located between the piston and the shoulder. Still another feature of the trigger device is that the housing may include a rupture disk in fluid communication with one side of the piston for creating a passage for wellbore fluid to the one side of the piston when a selected wellbore pressure is reached. A further feature of the trigger device is that the piston may be located in a chamber that is selectively exposed to hydrostatic pressure in the well to create the selected force on the piston. Another feature of the trigger device is that the housing may include a cavity for receiving the extrudable material after being pushed through the opening. An additional feature of the trigger device is that the extrudable material may comprise a sleeve mounted around a portion of the actuating member. Still another feature of the trigger device is that the extrudable material may comprise a polymer.

In another aspect, one or more of the foregoing advantages may also be achieved through a trigger device comprising a housing; a piston operatively carried by the housing, wherein the movement of the piston from a first position to a second position causes a downhole tool to perform a specified function; and a restraining member operatively associated with the piston to initially prevent movement of the piston from the first position to the second position, the restraining member comprising a solid extrudable material adjacent an opening, the opening being located in a shoulder in the housing and the extrudable material being located between the piston and the shoulder, wherein a selected force acting on the piston causes the piston to push at least a portion of the extrudable material through the opening, allowing the piston to move from the first position to the second position.

A further feature of the trigger device is that the extrudable material may be a polymer. Another feature of the trigger device is that the housing may include a rupture disk in fluid communication with one side of the piston for creating a passage for wellbore fluid to the one side of the piston when a selected wellbore pressure is reached. An additional feature of the trigger device is that the piston may be located in a chamber that is selectively exposed to hydrostatic pressure in the well to create the selected force on the piston. Still another feature of the trigger device is that the housing may include a cavity for receiving the extrudable material after being pushed through the opening. A further feature of the trigger device is that the extrudable material may comprise a sleeve mounted around a portion of the actuating member.

In an additional aspect, one or more of the foregoing advantages may be achieved through a method of selectively actuating a downhole tool. The method comprises the steps of: (a) retaining an actuating member of a downhole tool against movement with a restraining member, wherein the restraining member comprises at least one solid extrudable material located adjacent an opening; (b) lowering the tool into a wellbore; (c) applying a force to the actuating member; and then (d) pushing the extrudable material with the actuating member through the opening and actuating the downhole tool in response to the movement of the actuating member.

A further feature of the method of selectively actuating a downhole tool is that step (c) may be performed by placing the actuating member into fluid communication with a wellbore environment. Another feature of the method of selectively actuating a downhole tool is that step (c) may be performed by applying hydrostatic pressure of the wellbore to a piston of the actuating member. An additional feature of the method of selectively actuating a downhole tool is that step (c) may be performed by isolating the piston of the actuating member from wellbore fluid in the wellbore until reaching a desired setting depth, then placing the piston of the actuating member in fluid communication with the wellbore fluid. Still another feature of the method of selectively actuating a downhole tool is that the piston of the actuating member may be placed in fluid communication with hydrostatic pressure of the wellbore by rupturing a rupture disk.

The trigger devices and methods disclosed herein have one or more of the following advantages: permitting customization of the trigger device such that the amount of time for the trigger device to be activated is pre-determined; permitting steady movement of the actuating device at a known rate; and permitting setting of downhole tools without the need for heat from an external heating source other than wellbore temperature.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional view of one specific embodiment of the trigger device of the present invention shown in its initial or run-in position.

FIG. **2** is a cross-sectional view of the trigger device shown in FIG. **1** in its actuated position.

FIG. **3** is an enlarged cross-sectional view of the piston shown in FIG. **2** in its actuated position.

While the invention will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the invention to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF INVENTION

Referring to FIGS. **1**-**3**, in one embodiment, trigger device **10** is included as part of downhole tool **100**. Downhole tool **100** is lowered on a string of conduit into the well and may be used for setting a packer, a bridge plug, or various other functions. Trigger device **10** has actuating member **12**, which as shown in FIGS. **1**-**3**, is piston **14**. Generally, movement of actuating member **13**, e.g., piston **14**, sets downhole tool after it is properly located in a well (not shown). As shown in FIG. **1**, piston **14** is in its initial or “run-in” position. The initial position is the position prior to actuation of downhole tool **100**. FIGS. **2** and **3** show piston **14** in the actuated position.

In this embodiment, piston **14** comprises a sleeve carried in an annular chamber around a central mandrel assembly **16** of tool **100** and within a housing **18** of tool **100**. Piston **14** has inner and outer seals **20** that slidably engage mandrel assembly **16** and the inner side wall **22** of housing **18** when actuated. Piston **14** is connected to tool actuator **24** by key **25** extending through an elongated slot in mandrel assembly **16** to move tool actuator **24** downward, i.e., in the direction of the arrow, when piston **14** moves downward. Tool actuator **24** performs a desired function, such as setting a packer. Thus, downhole tool **10** is actuated and functional as a result of tool actuator **24** being moved.

During actuation of piston **14** and, thus, tool actuator **24**, a force is applied to piston **14** in the direction of the arrow. The force can come from a variety of sources such as hydrostatic pressure, fluid pressure pumped from the surface, or various springs or other energy storage devices or equivalents. When applied, the force would otherwise move piston **12** in the direction of the arrow except that restraining member **26** initially restricts, prevents, or otherwise limits movement of piston **14**.

Retaining member **26** facilitates maintenance of actuating member **12**, e.g., piston **14**, in the run-in position. As shown in FIG. **1**, retaining member **26** is completely formed of an extrudable material **27**. However, it is to be understood that retaining member **26** may be only partially formed by an extrudable material such that the extrudable material comprises only a portion of retaining member **26**. In this example, retaining member **26** comprises a sleeve within an inner diameter portion of piston **14**. Retaining member **26** and piston **14** are arranged so that piston **14** cannot move relative to retaining member **26** in the direction of the arrow until the force discussed above is applied. An inward extending lip **28** of piston **14** contacts an upper end of retaining member **26** to limit downward movement of piston **14** relative to retaining member **26**.

Retaining member **26** has an inner diameter that receives mandrel assembly **16**. Retaining member **26** is mounted to mandrel assembly **16** in a manner to restrict movement of retaining member **26** relative to mandrel assembly **16** in the direction of the arrow. In this embodiment, a lower end of retaining member **26** engages an upward facing shoulder **30** of mandrel assembly **16** to prevent downward movement. In the specific embodiment shown in FIGS. **1-3**, mandrel assembly **16** includes annular cavity **32** disposed below upward facing shoulder **30**.

Annular cavity **32** is defined by outer and inner cylindrical walls **33**, **35** on mandrel **16**. The bottom of annular cavity **32** is closed and the top of annular cavity **32** is defined by shoulder **30**. Piston **14** has a seal **37** on lip **28** that seals against mandrel **16** above shoulder **30**. Seal **39** on piston **14** seals against mandrel outer wall **33**. Vent **41** vents annular cavity **32** to the exterior of mandrel **16**. Restricted opening **34** in shoulder **30** provides fluid communication between retaining member **26** and annular cavity **32**. While in the "run-in" position (FIG. **1**), annular cavity **32** is preferably empty and at atmospheric pressure. During movement of downhole tool **100** from the run-in position to the "set" position (FIGS. **2-3**), the extrudable material **27** of retaining member **26** is moved, i.e., forced or extruded, through opening **34** into annular cavity **32** by the force acting downward on piston **14**. In certain specific embodiments, numerous openings **34** are present. Further, the size of the one or more openings **34** can be easily customized for each specific downhole tool **100** and the desired rate of movement for actuation of downhole tool **100**.

The term "extrudable material" as used herein for retaining member **26** means that the material is capable of being moved, e.g., forced or extruded through opening **34** when downhole tool **100** is moved from the unset position (FIG. **1**) to the set position (FIGS. **2-3**). "Extrudable material" refers to a solid material that can be forced through an opening under a force caused by wellbore pressure and temperature.

The extrudable material may be any material known to persons of ordinary skill in the art that can be moved, e.g., compressed, deformed, or extruded, over an amount of time by a force acting on actuating member **12**. Preferably, the extrudable material is calibrated such that the amount of time necessary for the extrudable material to be moved sufficiently to permit actuating member **12** to move from the unset position to the set position is known or easily determinable without undue experimentation. Suitable extrudable materials include polymers and elastomers, for example, the polymer HYDROCENE™ available from Idroplax, S.r.l. located in Altopascia, Italy. Preferably, extrudable material **27** is a toroidal-shaped single member, but it could comprise a plurality of beads of material.

In calibrating the rate of extrusion of the extrudable material, generally the rate is dependent on the density and hardness or malleability of the extrudable material. In one embodiment, the extrudable material is sufficiently movable over a period of time ranging from 1 hour to 240 hours and over a temperature range from about 50° C. to 250° C. Preferably, the force exerted by actuating member **12**, the amount of time that the force is applied, and the temperature within downhole tool **100**, which is usually the same as the wellbore temperature and which increases the flowability of the extrudable material, all act together to move the extrudable material; however, the temperature should be less than the melting point of extrudable material. Thus, the extrudable material does not begin moving through opening **34** solely by movement of piston **14**. Instead, an elevated temperature can also be present to facilitate movement of the extrudable material. Additionally, the size of opening **34** through which the extrudable material is extruded in certain embodiments can also, either alone or in combination with force, time, and/or well temperature, facilitate movement of the extrudable material.

It is to be understood that the apparatuses and methods disclosed herein are considered successful if the extrudable material **27** is sufficiently moved such that the actuating member **12**, e.g., piston **14**, is moved from its initial or "run-in" position (FIG. **1**) to its actuated or "setting" position (FIGS. **2-3**) so that the downhole tool is set. In other words, the apparatuses and methods are effective even if all of the extrudable material **27** is not moved out by the actuating member **12**. In one specific embodiment, at least 50% of the extrudable material **27** is moved. In other specific embodiment, at least 90% of the extrudable material **27** is moved.

Still with reference to FIG. **1**, trigger device **10** also includes rupture disk **38** that is designed to break-away at predetermined depths due to hydrostatic pressure of the well fluid or fluid pressures applied by pumps at the surface of the well. Rupture disks **38** are known in the art. Upon rupturing, rupture disk **38** forms passage **42** through which fluid can flow to contact the upper side of piston **14**.

In operation, downhole tool **100** is lowered into a well (not shown) containing a well fluid by a string (not shown) of conduit that would be attached to mandrel assembly **16**. In one technique, during the running-in, the portion of piston **14** above seals **20** and retaining member **26** are isolated from wellbore fluid, and tool actuator **24** and the portion of piston **14** below seals **20** are also isolated from wellbore fluid. The pressure on the upper and lower sides of seals **20** would be at atmospheric. The pressure difference on the exterior and interior sides of rupture disk **38** would be the difference between the hydrostatic pressure of the well fluid and atmospheric. Upon reaching a certain depth or a certain hydrostatic pressure of well fluid, rupture disk **38** breaks away, forming passage **42** and exposing the upper side of piston **14**, through passage **42**, to the wellbore environment. Fluid enters passage **42** and contacts the upper side of piston **14**. This fluid is at the hydrostatic pressure of the wellbore fluid and exerts a downward force on piston **14** because the pressure below seals **20** is atmospheric. This downward force on piston **14** is initially resisted by retaining member **26**. After a sufficient amount of time, preferably pre-determined by the operator of the downhole tool, the downward force overcomes the resistance of the restraining member **26** and extrudable material **27** of restraining member **26** begins to be moved, or extruded, through opening **34** and into chamber **32** such that retaining member **26** is no longer able to maintain actuating member **12**, e.g., piston **14**, in its "run-in" position. As a result, actuating member **12**, e.g., piston **14**, moves downward and actuates downhole tool **100** by moving tool actuator **24** downward to the position shown in FIGS. **2** and **3**.

Although the trigger device described in greater detail with respect to FIGS. **1-3** is directed to actuation of a piston as the actuating member, it is to be understood that the trigger device disclosed herein may be used in connection with any type of actuatable device known to persons of ordinary skill in the art. For example, the actuating member may be valve, ring or collet of a retractable seat such as a retractable ball seat, or any other device or member of a downhole tool that can be actuated.

Additionally, as well be recognized by persons of ordinary skill in the art, downhole tool **100** can be customized for controlled and steady actuation based upon different types of extrudable materials, larger or smaller volumes of extrudable materials, different shapes of extrudable materials, larger or smaller opening(s), higher or lower wellbore temperatures, and higher or lower forces acting on actuating member to move or extrude the extrudable material.

It is to be understood that the invention is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. For example, the retaining member may be formed completely out of the extrudable material. Alternatively, extrudable fasteners or other structural components may hold retaining member in place. Upon movement of the extrudable material, the retaining member falls out of or otherwise becomes removed from its retaining position and, thus, the actuating member is permitted to move. Moreover, although movement of a piston is shown in most of the embodiments herein as the apparatus and method for setting the downhole tool, any type of trigger device for the downhole tool is envisioned regardless of shape or the nature of its movement or whether the movement directly or indirectly sets the downhole tool. Additionally, the downhole tool does not require a separate chamber especially and solely designed for receiving the extrudable material. Instead, the extrudable material can be moved into any suitable void already carried within the downhole tool. Further, more than one opening may be in fluid communication with the chamber and the extrudable material of the restraining member to increase the rate of extrusion of the extrudable material and, thus, increase the rate of actuation of the downhole tool. Moreover, the trigger devices may not have a chamber or openings into and through which the extrudable material is extruded. Instead, the extrudable material is sufficiently compressible to allow actuation of the downhole tool. Also, the rupture disk could be eliminated, and the extrusion beginning as a result of exposure to temperature and wellbore hydrostatic pressure for a selected time. The piston could be exposed to hydrostatic pressure on both sides, but have differential pressure areas to cause movement. Accordingly, the invention is therefore to be limited only by the scope of the appended claims.

What is claimed is:

1. A trigger device for a downhole well tool, the trigger device capable of selectively actuating the downhole tool, the trigger device comprising:

a housing;

an actuating member operatively carried by the housing, wherein the movement of the actuating member from a first position to a second position causes a downhole tool to perform a specified function; and

a restraining member operatively associated with the actuating member to initially prevent movement of the actuating member from the first position to the second position, the restraining member comprising a solid extrudable material adjacent an opening,

wherein a selected force acting on the actuating member causes the actuating member to push at least a portion of the extrudable material through the opening, allowing the actuating member to move from the first position to the second position.

2. The trigger device of claim **1**, wherein the actuating member comprises a piston.

3. The trigger device of claim **2**, wherein the extrudable material is mounted in contact with the piston.

4. The trigger device of claim **3**, wherein the opening is located in a shoulder in the housing and the extrudable material is located between the piston and the shoulder.

5. The trigger device of claim **4**, wherein the housing includes a rupture disk in fluid communication with one side of the piston for creating a passage for wellbore fluid to the one side of the piston when a selected wellbore pressure is reached.

6. The trigger device of claim **2**, wherein the piston is located in a chamber that is selectively exposed to hydrostatic pressure in the well to create the selected force on the piston.

7. The trigger device of claim **1**, wherein the housing includes a cavity for receiving the extrudable material after being pushed through the opening.

8. The trigger device of claim **1**, wherein the extrudable material comprises a sleeve mounted around a portion of the actuating member.

9. The trigger device of claim **1**, wherein the extrudable material comprises a polymer.

10. A trigger device for a downhole well tool, the trigger device capable of selectively actuating the downhole tool, the trigger device comprising:

a housing;

a piston operatively carried by the housing, wherein the movement of the piston from a first position to a second position causes a downhole tool to perform a specified function; and

a restraining member operatively associated with the piston to initially prevent movement of the piston from the first position to the second position, the restraining member comprising a solid extrudable material adjacent an opening, the opening being located in a shoulder in the housing and the extrudable material being located between the piston and the shoulder,

wherein a selected force acting on the piston causes the piston to push at least a portion of the extrudable material through the opening, allowing the piston to move from the first position to the second position.

11. The trigger device of claim **10**, wherein the extrudable material is a polymer.

12. The trigger device of claim **10**, wherein the housing includes a rupture disk in fluid communication with one side of the piston for creating a passage for wellbore fluid to the one side of the piston when a selected wellbore pressure is reached.

13. The trigger device of claim **10**, wherein the piston is located in a chamber that is selectively exposed to hydrostatic pressure in the well to create the selected force on the piston.

14. The trigger device of claim **10**, wherein the housing includes a cavity for receiving the extrudable material after being pushed through the opening.

15. The trigger device of claim **10**, wherein the extrudable material comprises a sleeve mounted around a portion of the actuating member.

16. A method of selectively actuating a downhole tool, the method comprising the steps of:

(a) retaining an actuating member of a downhole tool against movement with a restraining member, wherein the restraining member comprises at least one solid extrudable material located adjacent an opening;

(b) lowering the tool into a wellbore;

(c) applying a force to the actuating member; then

(d) pushing the extrudable material with the actuating member through the opening and actuating the downhole tool in response to the movement of the actuating member.

17. The method of claim **16**, wherein step (c) is performed by placing the actuating member into fluid communication with a wellbore environment.

18. The method of claim **16**, wherein step (c) is performed by applying hydrostatic pressure of the wellbore to a piston of the actuating member.

19. The method of claim **18**, wherein step (c) is performed by isolating the piston of the actuating member from wellbore fluid in the wellbore until reaching a desired setting depth, then placing the piston of the actuating member in fluid communication with the wellbore fluid.

20. The method of claim **18**, wherein the piston of the actuating member is placed in fluid communication with hydrostatic pressure of the wellbore by rupturing a rupture disk.

* * * * *